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Abstract

OPERATING EXPERIENCE WITH BOILING WATER REACTORS

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The operating experience of three utility-owned and -operated reactors will be included in this report: Commonwealth Edison Company's Dresden, Pacific Gas and Electric Company's Humboldt Bay, and Consumers Power Company's Big Rock Point.

These reactors represent different design concepts. Dresden is a large dual-cycle boiling water reactor, designed for maximum flexibility of operation on a large electric utility system. It combines the features of both pressurized and boiling water reactor types. The Big Rock Point reactor is a forced-circulation boiling water unit designed for high-power-density fuel and operation at variable pressures in order to advance reactor technology. The Humboldt Bay unit was designed to produce economic nuclear power in its area. This has been accomplished by elimination of heat exchangers and recirculating pumps in the design of the natural-circulation boiling water reactor.

Nuclear performance tests have verified the inherent safety features of the boiling water reactor. The large boiling water reactors have demonstrated that cores having many critical masses are stable and easy to control. The control-rod arrangements are such that the worth of individual rods is minimized and power distribution easily controlled. Very little rod motion is required to compensate for xenon variations, even in the most severe cases, and there has been no instability due to xenon.

The reactor water chemistry of boiling water reactors has been found to be relatively simple. No chemicals need to be added to the reactor water system. The main criterion for reactor water treatment is complete demineralization.

Radiation levels with the plants at full power have demonstrated the adequacy of the shielding provided for both direct and scattered neutrons and

gammas. Discharge of radioactivity to the environs has been closely monitored at all plants. The levels of activity discharged in all cases have been remarkably low -- well below the limits specified by the United States Atomic Energy Commission.

Fuel-handling experience has indicated that simple fuel-handling mechanisms, together with good plant layout, can minimize outage time. Experience gained at Dresden has resulted in improvements on the newer reactors, such as eliminating the need for moving fuel in and out of the containment vessel during shutdown, and by providing bottom-entry in-core instrumentation.

Early mechanical difficulties encountered at both Dresden and Big Rock Point were solved satisfactorily. At Dresden the control-rod drives had to be modified early in operation. Inspections conducted after a substantial period of power operation revealed that the original problems had been solved; the improved designs were incorporated in later reactors. At Big Rock Point excessive vibration of the core fuel-support tube and channel assemblies was detected during early testing. It was necessary to unload the fuel to facilitate modifications to correct the difficulty. Subsequent tests revealed that these modifications produced satisfactory performance.

Maintenance of these plants during operation has consisted primarily of reparing steam or water leaks on conventional valves and equipment. Control-rod-drive maintenance has posed no major problem. The improved control-rod drives on the Big Rock Point and Humboldt reactors can be removed, serviced and replaced without removing the vessel head. Turbine overhaul after extended reactor operation, including operation with known leaking fuel assemblies, is not significantly different from that of a conventional plant.

The ability of these plants to follow utility system load schedules has been definitely established. The actual operation has proved to be relatively simple, and automatic load control is planned for at least one of these units in the near future.